

## MANAGEMENT OF THE WAMPU RIVER IN REDUCING FLOOD RISK IN TANJUNG PURA DISTRICT, LANGKAT REGENCY

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### ABSTRACT

Recurrent flooding in Tanjung Pura District, Langkat Regency, has had a significant impact on the community and infrastructure. This study aims to analyze the physical condition of the Wampu River, the factors causing the flooding, its impact on the community and infrastructure, and sustainable river management strategies. This study used a descriptive qualitative approach with data collection techniques through in-depth interviews, participatory observation, and documentation. Data analysis was conducted using the interactive model of Miles, Huberman, and Saldana (2014). The Results indicate that river channel siltation, land use changes, high rainfall, and infrastructure damage are the main causes of flooding. These recurring floods impact homes, agricultural land, public facilities, and public health and well-being. Effective river management strategies include watershed rehabilitation, flood control infrastructure improvements, sedimentation control, increased community participation, and inter-agency coordination. This study provides recommendations for policymakers and the community to implement sustainable river management in flood risk mitigation efforts.

### Introduction

Tanjung Pura District, Langkat Regency, is one of the areas crossed by the Wampu River, which has an important role in the social, economic, and environmental life of the local community. This river is not only a source of irrigation for agricultural land, but also serves as a means of transportation and a provider of water needs for the community. However, the vital role of the Wampu River is often threatened by the risk of flooding that occurs periodically, especially during the rainy season. This flood phenomenon has a significant impact, ranging from damage to infrastructure, disruption of economic activities, to a decline in the quality of life of people in the affected areas. Several studies and reports show that the main cause of flooding in Tanjung Pura District does not only come from high rainfall, but is also related to suboptimal river management conditions.

Sedimentation, narrowing of river flows due to settlements, and lack of water control facilities such as embankments and drainage channels are factors that exacerbate the risk of flooding. This condition is exacerbated by changes in land use patterns in upstream areas, where the conversion of land into agricultural and residential areas reduces the ability of water catchment areas. Furthermore, the lack of coordination between local governments, parties related to river management, and local communities in maintaining the preservation of the Wampu River makes flood mitigation efforts less effective. People often face floods as an annual event that is destructive, causing repeated material and social losses. This condition emphasizes the need for in-depth research on the management of the Wampu River in the context of flood risk, in order to produce more effective and sustainable management strategies. With this background, this study focuses on the analysis of the management of the Wampu River and flood risk mitigation efforts in Tanjung Pura District. This research is expected to provide a comprehensive overview of the factors that cause flooding, river management constraints, and solutions that can be applied by the government and the community to reduce flood risk in this region.



Figure 1.1 Management of the Wampu River at Risk of Flooding in Tanjung Pura District, Langkat Regency

Historical data shows that Tanjung Pura District, Langkat Regency, is an area prone to flooding. Several flood events recorded between 2021 and 2022 show a significant pattern of river overflow, which has a real social and infrastructure impact on the community. For example, on November 11, 2021, floods hit three sub-districts at once, namely Wampu, Batang Serangan, and Padang Tualang, with water levels between 20–80 cm. The impact of this flood reflects the region's vulnerability to heavy rains and river overflows, especially in low-lying areas near the Wampu River flow.

A similar situation also occurred in 2022. On October 10, 2022, floods hit Wampu District, including Stabat Lama Village and Gohor Village, with water levels reaching 80 cm. Then, on November 2, 2022, floods occurred again in Tanjung Pura and Besitang Districts, showing that floods are not only sporadic but tend to recur. At its peak, on November 3, 2022, floods submerged several villages in Tanjung Pura District, such as Pantai Cermin Village, Paya Perupuk Village, Suka Maju Village, Pekuburan Village, and Pekan Tanjung Pura Village, with water levels between 30–50 cm, which resulted in thousands of families being affected. Finally, on December 9, 2022, flooding extended to 4 villages in Tanjung Pura and 2 villages in Hinai, with water levels of 10–90 cm. The data illustrates that floods in Tanjung Pura District are not only a seasonal phenomenon, but are a recurring problem and have a fairly wide impact on people's lives, including damage to homes, disruptions of economic activities, and potential health risks. This phenomenon

emphasizes the importance of effective management of the Wampu River as part of flood risk mitigation.

The urgency of this research arises from the fact that Tanjung Pura District, Lalat Regency, is an area that is very prone to flooding due to the overflow of the Wampu River. Historical data shows that floods occur repeatedly, with water levels varying between 10–90 cm, inundating tens to hundreds of houses, submerging thousands of families, and disrupting social and economic activities of the community. This condition shows that the current river management is not optimal, both in terms of technical and flood control policies, so that the community continues to face high risks every rainy season. In addition, the impact of repeated floods causes material and social losses, such as damage to infrastructure, disruption of agricultural productivity, and potential public health risks. The community's dependence on the Wampu River for irrigation and daily water needs makes this issue not only an environmental issue, but also an urgent socio-economic problem to be solved.

With this background, this research is important and feasible because it can provide an empirical picture of the main causes of flooding in Tanjung Pura District, including hydrological factors, sedimentation, and river management. It is the basis for developing a more effective, sustainable, and participatory river management strategy, involving the government, the community, and related parties. Supporting the creation of flood risk mitigation policies, so that social and economic losses due to floods can be minimized. Provide academic contributions in the field of water resources management and disaster mitigation, which can be a reference for similar research in other areas. In the context of this study, flood incidence data serves as an empirical indicator to analyze how the physical condition of the river, sedimentation, flow narrowing, and management of embankments and drainage play a role in the occurrence of flooding. This is in line with the purpose of the research, which is to assess the effectiveness of the management of the Wampu River in reducing flood risk and formulate a more sustainable management strategy, both in terms of technical, environmental, and local community participation. Thus, this study is not only descriptive, but also provides a basis for flood mitigation policy recommendations in Tanjung Pura District.

### **Problem Identification**

Based on the background and data of flood events in Tanjung Pura District, several main problems related to the management of the Wampu River can be identified:

1. High and recurrent flood frequency  
Floods in Tanjung Pura District occur almost every rainy season with water levels varying between 10-90 cm, thus posing a continuous risk to the community.
2. Infrastructure damage and socio-economic impact  
Thousands of houses were submerged, economic activities were disrupted, and people suffered material and social losses.
3. Suboptimal river management  
There is sedimentation, narrowing of river flows, and lack of flood control facilities such as embankments, drainage, and water runoff channels.
4. Lack of coordination between related parties  
Coordination between local governments, communities, and river managers is still limited, so flood mitigation efforts have not been maximized.

## 5. The Impact of Land Use Change

Conversion of land upstream to settlements and agricultural land reduces water catchment areas and exacerbates river overflow.

### **Problem Formulation**

Based on the identification of the above problems, this research is formulated in several research questions as follows:

1. What is the current physical condition and management of the Wampu River in Tanjung Pura District in dealing with flood risk?
2. What are the factors that cause recurrent floods in Tanjung Pura District?
3. What is the impact of flooding on the community and infrastructure in Tanjung Pura District?
4. What kind of river management strategies can be implemented to reduce flood risk in a sustainable manner?

### **Literature Review**

#### **Water and River Resources Management**

Water resources management (SDA) is an effort to plan, implement, monitor, and evaluate water use in a sustainable manner. According to Law Number 17 of 2019, natural resource management aims to meet water needs for human life, agriculture, industry, and ecosystems, as well as to reduce the risk of disasters such as floods and droughts. In this context, river management must consider technical, ecological, social, and economic aspects in an integrated and participatory manner.

#### **Floods and Their Causes**

Flooding is an event of submersion of land that is generally dried by water, starting from water sources near the ground. The main causes of flooding include:

1. High rainfall: Heavy rainfall in a short period of time can cause the water flow to exceed the capacity of the river.
2. River sedimentation: The accumulation of sediment in the riverbed reduces the water holding capacity.
3. Land use change: Conversion of land to settlements or agriculture reduces water permeability and increases surface flow.
4. Infrastructure damage: Damaged or inadequate levees or drainage channels can worsen flood conditions.

#### **Watersheds and Their Roles**

Watersheds are areas that receive rainwater and drain it into major rivers. Good watershed management can reduce the risk of flooding through:

1. Soil and water conservation: Planting vegetation to reduce erosion and increase water infiltration.
2. Forest rehabilitation: Restoration of forest areas upstream to maintain ecosystem balance.
3. Sedimentation control: Management of water flow to prevent sediment buildup in rivers

## **Integrated Approach in River Management**

Effective river management requires integration between various parties, including the government, communities, and the private sector. This includes:

1. Inter-agency coordination: Preparation of policies and programs that are in line between various related agencies.
2. Community participation: Community involvement in the planning, implementation, and monitoring of river management activities.
3. Monitoring and evaluation: Regular collection of data and information to assess the effectiveness of management and make improvements if necessary.

## **Flood Risk Mitigation Strategies**

Flood risk mitigation strategies include:

1. Construction of flood control infrastructure: Construction of embankments, drainage channels, and dams to regulate the flow of water.
2. Watershed rehabilitation: Planting of trees and vegetation to increase water absorption and prevent erosion.
3. Socialization and education: Counseling to the community about the importance of protecting the environment and disaster preparedness.

## **Research Method**

### **Types and Research Approaches**

This study uses a descriptive qualitative approach to understand in depth the phenomenon of Wampu River management in the context of flood risk in Tanjung Pura District. This approach is in line with the view of Creswell (2018) who states that qualitative research aims to explain social phenomena by exploring the meaning and experiences of research subjects in their natural context.

### **Research Location and Time**

This research was conducted in Tanjung Pura District, Langkat Regency, North Sumatra Province. This location was chosen because it often experiences floods which are suspected to be related to the management of the Wampu River. The research period lasted from January to June 2025.

### **Research Informant**

Research informants are determined through purposive sampling techniques, which are the selection of informants based on certain considerations that are relevant to the focus of the research. The informant consists of:

1. Village Head and village officials in Tanjung Pura District
2. Officers of the Regional Disaster Management Agency (BPBD) of Langkat Regency
3. People living around the Wampu River
4. Environmental activists and academics who have knowledge of river management and flood mitigation

The number of informants is adjusted to the need for data to reach the saturation point, which is the point where the information obtained no longer provides new data (Fusch & Ness, 2015).

### **Data collection techniques**

Data is collected through three main techniques:

1. In-depth interview: Conducted to explore the views, experiences, and perceptions of informants regarding the management of the Wampu River and its impact on flood risk. These interviews are semi-structured, allowing for flexibility in the exploration of topics.
2. Participatory observation: Researchers are directly involved in community activities and river management to observe the social dynamics and management practices that take place.
3. Documentation: Collect secondary data from related documents such as BPBD reports, river flow maps, local government policies, and mass media archives regarding flood events.

### **Data Analysis Techniques**

The data obtained were analyzed using an interactive analysis model developed by Miles, Huberman, and Saldana (2014), which consisted of three stages:

1. Data reduction: The process of selecting, focusing, and simplifying data obtained from the field.
2. Data presentation: Compile data in the form of a systematic narrative to facilitate understanding.
3. Conclusion drawn/verification: Draw up provisional conclusions and verify the data that has been analyzed.

### **Results and Discussion**

#### **What is the physical condition and management of the Wampu River in Tanjung Pura District currently in facing flood risk**

##### **Wampu River Management and Its Challenges**

The management of the Wampu River in Tanjung Pura District faces various challenges that affect its effectiveness in reducing flood risk:

1. Lack of Flood Control Infrastructure: Some areas, such as Pematang Sentang Hamlet in Pantai Cermin Village, do not have adequate embankments. As a result, river water overflowed into residential areas, causing floods with a height of up to one meter.
2. Lack of Coordination Between Related Parties: River management has not fully involved all relevant parties, including local governments, communities, and the private sector. This hinders effective and sustainable flood mitigation efforts.
3. Lack of Environmental Law Enforcement: In Pantai Cermin Village, the practice of illegal sand mining without a permit is still rampant. This is due to low public legal awareness and weak enforcement of environmental laws

The physical condition of the Wampu River which has experienced siltation and narrowing, as well as suboptimal management, contributes to the increased risk of flooding in Tanjung Pura District. Therefore, integrated and sustainable efforts are needed in river management, including watershed ecosystem rehabilitation, flood control infrastructure development, increased coordination between related parties, and strict enforcement of environmental laws.

### **What factors cause recurrent flooding in Tanjung Pura District**

The repeated flood events in Tanjung Pura District did not occur by chance, but were the result of an interaction between natural and human factors. Based on field data, observations, and various recent studies, some of the main factors that cause recurrent flooding in this region can be explained as follows:

1. **High Rainfall and Climate Variability**  
High rainfall and erratic intensity of rain during the rainy season are direct triggers for flooding. According to the Meteorology, Climatology, and Geophysics Agency (BMKG, 2022), Tanjung Pura District experienced heavy rain in several periods, which caused the flow of the Wampu River to exceed its normal capacity. This phenomenon is exacerbated by climate change which causes rainfall patterns to become more extreme, so the risk of flooding increases.
2. **Siltation and Narrowing of River Flows**  
Natural sedimentation activities and human activities, such as illegal sand mining and garbage accumulation in river bodies, cause siltation of river flows. The narrowing of the river flow reduces the capacity of water holding water, so that when heavy rain occurs, river water overflows into settlements and agricultural land.
3. **Land Use Change in the Upper River**  
The conversion of forest land and critical land into settlements or agricultural land in the upstream area of the Wampu watershed reduces water catchment areas. As a result, the surface flow increased, accelerating the discharge of water flowing downstream, and triggered flooding in Tanjung Pura District. This is in line with Priatim's (2021) research which shows that land use change is one of the main causes of flooding in watersheds.
4. **Damage to Infrastructure and Inadequate Drainage**  
Embankments, drainage channels, and dams at several points in Tanjung Pura District are often inadequate or damaged. Weak infrastructure makes rainwater and river overflows uncontrollable, thus increasing the potential for flooding.
5. **Lack of Community Coordination and Participation**  
The management of the Wampu River has not fully involved the local community and related parties optimally. Lack of public awareness to keep rivers from garbage and environmentally damaging practices also contribute to repeated flooding. Triangulation between the government, the community, and the private sector is still lacking, so flood mitigation is not optimal.

The factors causing flooding in Tanjung Pura District are a combination of natural factors, such as high rainfall and watershed characteristics, and human factors, such as changes in

land use, siltation of rivers, damage to infrastructure, and low community participation. Understanding these factors is important to design a more effective management strategy for the Wampu River in reducing the risk of recurrent floods, both through infrastructure development, watershed rehabilitation, and increased community participation.

### **What is the impact of flooding on the community and infrastructure in Tanjung Pura District**

Floods that occur repeatedly in Tanjung Pura District have a significant impact on people's lives and the condition of regional infrastructure. These impacts are multidimensional, including social, economic, and environmental aspects.

1. **Impact on Society**  
Floods directly affect people's lives, including:
  - a. **Loss of household and property:** Many people's homes were submerged to 50–90 cm in water levels, causing furniture, electronic devices, and food supplies to be damaged or lost.
  - b. **Health disorders:** Flooding increases the risk of diseases, such as diarrhea, dengue fever, and skin infections, as stagnant water is often contaminated by domestic waste and animal waste.
  - c. **Evacuation and disruption of daily activities:** Thousands of affected families have had to evacuate to safer places, disrupting children's education, work, and daily economic activities.
  - d. **Social and psychological stress:** Repeated floods create uncertainty and anxiety for residents living in vulnerable areas, affecting people's quality of life and psychological well-being.
2. **Impact on Infrastructure**  
Public infrastructure is also damaged that affects public services:
  - a. **Damaged roads and bridges:** Floodwaters damaged village roads and small bridges, cutting off access to transportation between villages and to the center of the district.
  - b. **Drainage channels and embankments:** Many waterways are clogged and embankments are broken, reducing flood control capabilities and exacerbating the impact of subsequent floods.
  - c. **Education and health facilities:** Schools, posyandu, and health facilities are often affected by floods, so public services are temporarily disrupted.
  - d. **Damage to agricultural land:** Floods submerge residents' farmland, causing crop failure and economic losses for farmers.
3. **Implications for River Development and Management**  
The impact of repeated floods shows that the current management of the Wampu River is not effective enough. Infrastructure damage and socio-economic losses to communities demand more integrated mitigation planning, including watershed

rehabilitation, dike and drainage repairs, and active community participation in maintaining river flows.

Flooding in Tanjung Pura District has a double impact, both on the community and infrastructure. This impact shows the urgency of more effective and sustainable management of the Wampu River, so that the risk of flooding can be minimized, community welfare increases, and regional development is not disrupted. This research is important to formulate a holistic river management strategy, combining technical, social, and environmental aspects.

### **What kind of river management strategies can be implemented to reduce flood risk in a sustainable manner**

Based on literature studies and observations in the field, the management of the Wampu River in Tanjung Pura District requires an integrated, participatory, and sustainable approach. This strategy must pay attention to technical, ecological, and social aspects so that flood risk can be effectively reduced. Some of the strategies that can be implemented are as follows:

1. **Watershed Rehabilitation and Conservation**  
Sustainable watershed management is the key to flood mitigation. Rehabilitation efforts include planting erosion-resistant vegetation upstream, reforestation of critical areas, and maintenance of green areas around river flows. According to Fathin (2024), watershed conservation can increase water catchment capacity and reduce surface flows that accelerate downstream flooding.
2. **Construction and Repair of Flood Control Infrastructure**  
Technical strategies include repairing embankments, drainage channels, and building reservoirs or retention ponds to accommodate excess rainwater. This infrastructure needs to be designed based on hydrological studies and river capacity, so that it can withstand water discharge during heavy rains without damaging the river ecosystem.
3. **River Sedimentation Management**  
The siltation of the river due to sedimentation increases the risk of flooding. Routine sediment management through controlled dredging and erosion prevention in the upstream of the river can maintain the depth and flow capacity of the Wampu River. This practice must also be carried out with regard to ecological aspects to avoid habitat damage.
4. **Increased Community Participation and Environmental Awareness**  
Local communities should be involved in river management, such as keeping the river clean, planting trees on the riverbanks, and complying with the rules prohibiting illegal sand mining. Active community participation can strengthen the effectiveness of flood mitigation strategies and increase collective awareness of the importance of the environment.
5. **Inter-Agency Coordination and Integrated Policy**  
Flood mitigation requires synergy between local governments, BPBD, the Natural Resources Office, and the community. The preparation of an integrated river management plan, which includes technical, social, and environmental policy aspects, can ensure that each strategy runs effectively and sustainably.

#### 6. Continuous Monitoring and Evaluation

The river management strategy must be supported by a monitoring system for water discharge, rainfall, and the physical condition of the river. Periodic evaluations allow for strategy improvement, early detection of flood risks, and adaptation to climate change and watershed conditions.

A sustainable management strategy for the Wampu River must be holistic, incorporating watershed conservation, infrastructure improvement, sedimentation control, community participation, inter-agency coordination, and continuous monitoring. With the implementation of this strategy, the risk of flooding in Tanjung Pura District can be reduced, while increasing community resilience and environmental quality along the Wampu River flow.

#### Conclusion

Based on the results of qualitative research conducted through in-depth interviews, participatory observations, and documentation, the following can be concluded:

1. The physical condition of the Wampu River in Tanjung Pura District is experiencing siltation, narrowing of channels, and a decrease in water quality due to sedimentation, damage to watershed ecosystems, and human activities such as illegal sand mining and domestic waste disposal. This condition increases the risk of flooding every rainy season.
2. Factors that cause recurrent floods include high rainfall, siltation and narrowing of rivers, changes in land use upstream, damage to flood control infrastructure, and lack of coordination and community participation in maintaining rivers.
3. The impact of floods on communities and infrastructure includes material losses to houses and agricultural land, health problems, displacement, damage to roads and bridges, and disruption of education and health service facilities.
4. Sustainable management strategies for the Wampu River include watershed rehabilitation, repair and development of flood control infrastructure, sedimentation control, increased community participation, inter-agency coordination, and continuous monitoring and evaluation. This strategy is expected to reduce flood risk while increasing the social and ecological resilience of the region.

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